28

MAR 2 1942

AGRICULTURAL NEWS LETTER

VOL.10 - NO.1 JANUARY-FEBRUARY, 1942

This publication contains information regarding new developments of interest to agriculture based on laboratory and field investigations of the du Pont Company and its subsidiary companies. It also contains published reports and direct contributions of investigators of agricultural experiment stations and other institutions as related to the Company's products and other subjects of agricultural interest.

DU PONT
REG. U.S. PAT. OFF

ISSUED BY PUBLIC RELATIONS DEPARTMENT, E. I. DU PONT DE NEMOURS & CO. (INC.), WILMINGTON, DEL.

Vol. 10 - No. 1 Jan.-Feb. 1942.

AGRICULTURAL NEWS LETTER

Editor
L. F. Livingston, Manager,
Agricultural Extension Division.

Contributing Editors

Dr. F. W. Parker, Agronomist,
Ammonia Department.

Gilbert F. Miles, Manager,
Research Laboratory,
Bayer-Semesan Company.

Dr. W. H. Tisdale, Director,
Pest Control Research Laboratory.

Dr. H. F. Dietz, Entomologist,
Pest Control Research Laboratory.

EDITOR'S NOTE: In the interest of paper conservation, we are beginning with this issue, and will continue "for the duration", to print the "AGRICULTURAL NEWS LETTER" on both sides of the paper. Through this means, we can conserve considerable paper for other needed uses.

- - - - - -

CONTENTS

Agricultural News Letter (Du Pont)
Vol. 10, No. 1, Jan.-Feb. 1942

SOUTHERN AGRICULTURAL WORKERS STRESS

RESEARCH AS WAR MEASURE

EDITOR'S NOTE: The imperative need for research and the proper direction of research in agriculture as a defense measure were stressed in resolutions recently adopted by the Association of Southern Agricultural Workers. This organization, representing more than 8,000 agricultural workers and leaders from both government and industrial organizations operating in the South, adopted resolutions dealing with such general subjects as cotton acreage, farm labor, coordination of farm programs, soil conservation, and priorities for certain agricultural materials and farm equipment. In addition a number of the resolutions, as reviewed below, requested renewed emphasis on agricultural research as a step toward victory in our war effort.

Research workers of the United States Department of Agriculture and of State Agricultural Experiment Stations were urged to give immediate and intensive attention to problems pertaining to agricultural production and defense, in a resolution adopted at the annual meeting of the Association of Southern Agricultural Workers in Memphis, Tenn., February 4, 5, and 6, 1942.

Other resolutions adopted by the Association recommended that:

Congress and State Legislatures be urged to give careful consideration to appropriation of funds for agricultural research so that this important defense activity shall be accelerated rather than curtailed, and to take such measures as will insure maximum concentration of research efforts upon problems directly relating to production for defense.

Recognition be given to the importance of technicians particularly fitted for the different branches of agricultural production, and that they may be given the same deferment in agriculture as in other basic industries.

Agricultural teaching, research and extension activities be adjusted to meet the demands of the emergency so that new problems arising may be disposed of as promptly as possible.

Appropriate Federal agencies to be advised of the inability of the South to produce needed crops without liberal quantities of fertilizers, and that these agencies be urged to give this fact special consideration in the allocation of nitrogen materials and mixed fertilizers.

Continued on next page

The various agencies concerned give particular attention and assistance in strengthening existing programs for promoting an increase of poultry and eggs on an efficient basis to meet war needs.

Government agencies be requested to make every effort to conserve larger quantities of the by-products derived from drying or processing of milk and other products in order that sufficient vitamin supplements may be available for efficient poultry and egg production to meet war demands.

Governmental educational, research and action agencies urge farmers to produce needed supplies of a farm-grown roughage of high quality, including hay, silage and pasture crops, and that there be no retrenchment of research pertaining to this subject.

Studies be made of the initial cost of production of livestock in Southern sections or areas so that the producers may be compensated for the initial cost, the cost of production and a reasonable profit.

"Appropriate authorities" make available to farmers sufficient quantities of insecticides, fungicides, fertilizer materials and machinery as are necessary to insure efficiency in the farm program.

The War Department grant leaves of absence to airplane pilots for insect control work (dusting) during July and August.

SULFAMIC ACID

In the Home - On the Farm - In the Lab

Sulfamic acid, recently introduced as a new industrial chemical in tonnage quantities by the Grasselli Chemicals Department of the Du Pont Company, has a variety of interesting uses of especial interest to research workers, both for laboratory use and for practical utilization on the farm and in the home.

As a Flameproofing Agent for Paper and Cloth

The ammonium salt of this chemical has proved itself a safe and highly effective flameproofing agent for paper, insulating materials and fabrics. It does not alter the appearance or adversely affect the "feel" of cloth. In many laboratories, smocks have been thus flameproofed by dipping. Workers' clothing in steel mills and ship-yards have been similarly treated. The possibilities for flameproofing paper and fabrics in the farm home are obvious. (For a more detailed discussion of this use, see page 4.)

As a Weed Killer

Ammonium sulfamate also has numerous possibilities as a safe and effective weed killing spray. Ragweed, posion ivy and other obnoxious plants can be eradicated without permanently injuring the fertility of the soil. (For more detailed discussion of this use, see page 6.)

As a Standard Reagent in the Laboratory

Sulfamic acid is being adopted as a standard reagent in various laboratory experiments, particularly that involving the removal of excess nitrites, especially in diazotization reactions. (For more detailed discussion of this use, see page 9.)

NOTE: Housewives are advised that in ironing treated cloth, better results will be obtained by using an iron at minimum temperature. A hot iron has a tendency to pick up the retardant and become sticky. A cool iron suitable for ironing acetate rayon will be generally satisfactory. Use of a pressing cloth whenever possible is recommended.

Agricultural News Letter (Du Pont)
Vol. 10, No. 1, Jan.-Feb. 1942

AMMONIUM SULFAMATE AS A FLAMEPROOFING AGENT FOR CLOTH, PAPER AND INSULATING MATERIALS

Fires on farms destroy $100,000,000 worth of property each year - about 30 per cent of the national losses from fire reports the Committee on Fire Prevention and Protection of the American Society of Agricultural Engineers. This huge loss is a serious drain upon the agricultural wealth of the country. If the farmers of the United States were assessed for the amount of the annual fire losses on farms, each farmer would have a yearly fire tax of nearly $15.

Blazes often start from fireplace sparks. Sometimes a flimsy window curtain blows over a gas range burner. Smoking is responsible for its share of fire. And children still like to play with matches.

From now on, most of these fires need never happen.

Thanks to chemical research, all the flammable fabrics in the home may be "flameproofed" - simply and effectively. With many of them, it's as easy as starching on wash day.

Annually, some 3500 fatalities on farms from burns are listed along with countless injuries. Many of these are attributable to clothing that caught fire.

A great decrease in such accidents is foreseeable by "flameproofing" our clothing.

For the sheerest negligee, a velvet evening gown, the farmer's overalls, the little girl's frilly party frock, all may be treated by dipping or spraying with the chemical so that, although they will char upon contact with fire, they will not flame or support combustion.

Fabrics immersed in a solution of one pound of the new fire retardant to one gallon of water, and then dried, will remain incapable of supporting fire until washed, when the treatment must be repeated. Dry-cleaning does not remove the fire protection quality or appreciably impair it.

Moreover, this chemical newcomer is said to be unique because it does not adversely affect the "feel" or appearance of fabrics. Indeed, it takes an expert - or a flame - to distinguish between treated and untreated goods.

Known technically as ammonium sulfamate, the new fire retardant was described on December 29th before the American Chemical Society at its meeting in Columbus. All the elements of an industrial romance are present in its short but robust history as told by two Du Pont chemists.

Until three years ago, sulfamic acid, the crystalline powder from which the ammonium salt for flameproofing is made, was a laboratory curiosity. All known

Continued on next page

methods of producing it were prohibitively costly, and had been since the acid was first tediously prepared by a Swedish chemist named Berglund 63 years ago.

Then, at the Experimental Station of the Du Pont Company, an economical way of making sulfamic acid was developed.

"So what?," was the immediate reaction of the chemists.

Scarcely one practical use was known for the acid. That was in 1939.

But a few weeks ago a plant to manufacture the new industrial chemical by the tons was opened in New Jersey. It is the first and only plant of its kind in the world. The reason for it being built is that sulfamic acid and its derivatives are now known to be useful for more than a dozen important purposes, ranging from leather tanning and dyeing processes, to killing poison ivy and ragweed - and now flameproofing textiles.

Because it affords such a high degree of protection against flame and flying sparks, the fire retardant has for some months now been used in airplane manufacture, in workmens' clothing in steel mills and in shipyards. One indicated immediate use is to immunize blackout cloth against fire. Civilian Defense authorities, it is understood, have been advised of the safety role ammonium sulfamate might play where and whenever an all-out protection program against fire is necessary.

Many state and municipal fire regulations now require that all combustible materials in places of public assembly be flameproofed. These include all hangings of cotton, paper, silk, rayon, and stage scenery in theaters, restaurants and other public meeting places. New York, Philadelphia, Detroit and Los Angeles have such regulations.

A disastrous fire in the chemical laboratory of a large university recently led to the flameproofing of students' "lab" smocks.

Of particular importance, safety engineers point out, is the flameproofing of pile fabrics. These are prone to "flash" burn - that is, flame will literally sweep across the nap in an instant.

Broad usage of the fire retardant is fairly certain to open up in two other fields where safety is an urgent need. One is in paper, especially for decorative purposes. The other adaption lies in treatment of insulating materials to prevent the spread of flames in frame dwellings.

Some progressive dry-cleaners and laundrymen already are offering customers a fire retardant treatment for clothing, bed-sheets, blankets and the like. It is predicted that textile mills will shortly begin flameproofing fabrics in course of manufacture.

And all this is just the beginning, say the chemists. In due course, perhaps we will all live in homes where a fire could be kindled only with difficulty, with consequent savings in many thousands of lives and millions in money.

Agricultural News Letter (Du Pont)
Vol. 10, No. 1, Jan.-Feb. 1942

Ammonium Sulfamate - its Herbicidal Properties Evaluated

Ammonium sulfamate will become available commercially on a limited scale this spring for weed-killing purposes. Its herbicidal properties, which were demonstrated by Martin E. and Harold Cupery in the spring of 1940, have now been tested over a period of two years by many capable investigators, and although its evaluation, especially for certain deep-rooted perennials is by no means completed, there is abundant evidence to support its use for the control of poison ivy, poison oak, Canada thistle, chokecherry, dewberry, ragweed, hoary cress or white-top, wild blackberry, perennial sow thistle, Russian thistle, dock, and a miscellany of noxious annual weeds.

Preliminary reports indicate that the field for use of ammonium sulfamate in weed control will be much extended in another year. The process of evaluating a chemical for weed control is necessarily a long one due to the many varieties of weeds and the other variable factors involved dealing with soil types, state of growth and seasonal or climatic conditions. Considerable experimental data has already been submitted pertaining to tests made with ammonium sulfamate on over one hundred specific weeds.

Initial experimental work is preferably conducted by agronomists, botanists, plant physiologists and weed specialists on the staff of public institutions, but ultimate evaluations must be made by the actual users of herbicidal chemicals. For this reason it is not desirable that ammonium sulfamate shall be sold in unlimited amounts and without certain reservations until its qualifications are fully established and its limitations well defined by usage in the field.

Both ammonium sulfamate and its parent acid, sulfamic acid, appeared to have equal merit as herbicides when they were tested side by side, except that weeds sprayed with sulfamic acid showed lethal effects more quickly and spectacularly. In most tests reported where the two were compared, the ammonium salt arrived at the same results as the acid did in the end, or proved even more effective than the acid, but there are a few exceptions where the action of the acid appears to be superior. As an example of this, one investigator found that ammonium sulfamate gave no complete control of Bermuda grass, while sulfamic acid at the same strength was very effective. When each chemical was applied to Nutgrass (Cyperus rotundus) the reverse was true, ammonium sulfamate proving superior. Since the acid is more corrosive in its action upon many metals than the salt, and is somewhat less soluble in water, it is expected that ammonium sulfamate will become the more generally accepted herbicide. Users are cautioned not to allow these solutions to remain in spraying equipment, and will be well advised to rinse out metal and hose thoroughly with water.

In the previous article on ammonium sulfamate presented in the Agricultural News Letter for March-April, 1941, entitled "Ammonium Sulfamate and Sulfamic Acid as Herbicides" by Dietz, Vogel and Cupery, it was shown that poison ivy

Continued on next page

(Rhus toxicodendron) was very sensitive to either of these chemicals. The results of the Delaware experiments described in this article have since been duplicated with ammonium sulfamate in New York, Connecticut, Rhode Island, Massachusetts, Pennsylvania, North Carolina, West Virginia, Kentucky, Indiana, Ohio, Michigan, Arkansas, and Texas. In California, ammonium sulfamate, in several tests where it was applied for killing poison oak (Rhus diversiloba), which is the western counterpart of poison ivy, caused the characteristic wilting, drying of leaves and destruction of woody tissue to appear in the sequence given.

There is evidence that ammonium sulfamate acts both through translocation from the leaves to the roots, and through its direct absorption by the roots when applied to the soil. When it was applied as a spray to a plot of morning-glory (Convolvulus arvensis) in October the leaves of the plants soon collapsed but the root system was still very much alive, and within thirty days they were growing as vigorously as ever. The plants continued to grow, until after the first rain. Immediately they turned yellow and within a few weeks time they were entirely dead. Only two or three morning-glory plants came up the following April, although some (Oxalis cernua,) which grow from a bulb, continued to thrive in the plot.

The kill in the case of poison oak appears to be through translocation only, since it is necessary to wet the foliage in order to obtain results. When the chemical is applied to the soil at the base of the plants but not applied to the foliage the growth of the poison oak does not appear to be affected.

Because of the prevailing dry summers in most of the western states, the timing of the application of herbicides in order to derive the greatest benefits, is an important consideration. As shown by Dietz, Vogel and Cupery the rapidity of action from ammonium sulfamate is influenced by humidity and rainfall. For deep-rooted perennials, applications in the late fall immediately preceding the rainy season would give time for the chemical to leach during the winter to lower soil levels where it would be more available for the deep roots. In the case of shallow rooted annual weeds and grasses, such a fall application would permit too much leaching as the chemical would have penetrated below the roots of the young seedlings by spring. Hence, for annual plants, a late spring application timed to catch the last rains, would give their young roots a maximum chance to absorb the chemical while it is in the surface layer of soil.

The importance of applying ammonium sulfamate to plants at their most susceptible stage of growth is illustrated in experiments reported from California, where Canada Thistle was the weed involved. In August, a block of Canada Thistle, some in the full bloom or past bloom stage, others in the immature rosette stage, were sprayed at a dosage of one pound of ammonium sulfamate per 100 square feet. The kill was remarkable on the matured plants, and the roots of such plants were killed for at least a foot below the soil surface. In California, where most plants of this species are not seed-forming, being either pure stands of staminate or pistillate flowering plants, such a kill means exceptional control. The rosette stage, however, proved to be very resistant, and none of the plants in this stage of growth were killed by the spray.

Continued on next page

The killing action of ammonium sulfamate on Canada Thistle also appears to be one of translocation, and the high susceptibility of the fully matured plants may be accounted for by their greater leaf surface as compared to the lesser leaf surface exposed by plants in the rosette stage.

It might be expected that grasses would be less likely to suffer injury from applications of ammonium sulfamate than heavy-foliaged, broad-leaved plants. Such, however, is not always the case. Among different species of grasses some selectivity has been displayed toward ammonium sulfamate. Dallis grass (*Paspalum dilatatum*) is easily killed by a single application of ammonium sulfamate, but Bermuda grass (*Cynodon dactylan*) seems to be highly resistant. Some interesting experiments are now in progress at Oregon State College where ammonium sulfamate is combined with other chemicals for the control of lawn weeds. In combination it appears that the concentration of ammonium sulfamate can be weakened sufficiently so that when used on lawns the grass stand will remain uninjured, but the solution will be strong enough to kill out such weeds as plantain, dandelion, sorrel, and hop clover (*Medicago lupulina*).

It must be remembered that where a chemical depends upon translocation for its maximum killing effect, the concentration must not be so high as to destroy the functioning of foliage before the chemical can be carried to the roots.

Another combination, that of ammonium sulfamate and sodium chlorate, was tried by an investigator in Minnesota, in the hope of reducing the fire hazard of sodium chlorate. The addition of ammonium sulfamate served to excite the inflammability of sodium chlorate, and the mixture burned furiously at the slightest provocation. When used alone, however, ammonium sulfamate definitely retards the combustibility of dead plant material, this investigator reports.

Ammonium sulfamate, a non-inflammable compound considered non-toxic to livestock on the basis of animal feeding tests, is particularly adapted for the control of weeds such as poison oak, ragweed and poison ivy growing in the vicinity of army camps, for keeping landing fields free from weeds, for use on railroad rights-of-way, in the neighborhood of filling stations and oil tanks, about lumber seasoning yards, and under wooden railroad trestles.

****

> There is room for considerable detailed research in this field in order to determine the efficiency and optimum methods of applying ammonium sulfamate to any specific type of weed under the particular local conditions which may be involved. To facilitate investigations of this kind, the Grasselli Chemicals Department of the Du Pont Company is offering samples of the chemical to qualified investigators who are in a position to conduct suitable comparative tests.

##########

Agricultural News Letter (Du Pont)
Vol. 10, No. 1, Jan.-Feb. 1942

SULFAMIC ACID AS A REAGENT FOR LABORATORY USE

Sulfamic acid is being adopted as a standard reagent in various laboratory experiments involving the removal of excess nitrites, especially in diazotization reactions.

In a paper recently delivered before the American Chemical Society at Columbus, Ohio, Drs. M. E. Cupery and W. E. Gordon of the Du Pont Company listed the following laboratory uses for sulfamic acid and its salts:

1. Titrimetric standard (indicator pH range 4.5-9).
2. Diazotization reactions (dye preparations).
3. Analytical procedures for nitrite analysis and determination of oxygen in water analysis.
4. Extraction of rare earth metals.
5. Miscellaneous experimental uses: preparing dry N_2O from HNO_3 + HSO_3NH_2 and determining water of hydration in calcium sulfamate.

It has been shown that sulfamic acid is an excellent acidimetric standard of reference in analytical chemistry, being superior to such standards as benzoic acid, succinic acid, potassium biiodate and potassium acid phthalate.

The reaction of sulfamic acid with nitrous acid is exceedingly rapid and proceeds quantitatively. Therefore, its use can be recommended for improved analytical procedure for the determination of nitrites.

It is also reported that the separation of lanthanum earth metals from the yttrium rare earth group is facilitated through the use of sulfamic acid.

Moreover, hydrated calcium sulfamate is readily dehydrated at temperatures above 69.4° C. As the hydrated salt is quite easily prepared in the laboratory, this salt should be especially suitable for determinations of water of hydration as carried out in elementary chemistry courses.

The preparation of dry nitrous oxide gas is easily accomplished by simply heating nitric acid with sulfamic acid. An experiment of this type might well supplement the ordinary laboratory experiment based on a heat decomposition of ammonium nitrate.

Additional elementary experiments might be devised in which the solid, nonhygroscopic nature of sulfamic acid would be advantageous because of greater accuracy, convenience, and safety in handling.

Agricultural News Letter (Du Pont)
Vol. 10, No. 1, Jan.-Feb. 1942.

FORMALDEHYDE FUMIGATION OF INCUBATING EGGS

EDITOR'S NOTE: "Effect of Formaldehyde Fumigation on Mortality of Chicken Embryos," by W. M. Insko, Jr., Dewey G. Steele and Cecil M. Hinton, is the title of Bulletin 416 of the Kentucky Experiment Station at the University of Kentucky in Lexington. A summary of the experimental work and practical recommendations reported are given below. The technical information contained in this article is selected because of its possible interest to the reader. In so far as this information may be protected by patents it should not, of course, be used without the consent of the patent owner.

The experimental work reported in Kentucky Experiment Station Bulletin 416 involved fumigation of incubating eggs in the range between three times and four times normal concentration of fumigant. Within this range there was a positive relationship between concentration of fumigant and mortality of embryos. Embryo losses were not great enough to be of practical importance, however, until the concentration of fumigant was more than four times normal. Fumigation at normal concentration - about 35 cc. of 37% by weight (40% by volume) formaldehyde solution per 100 cubic feet of incubator space - has been shown by several workers to be relatively harmless to the chick embryo at any stage of incubation.

The early "critical period of incubation," the second and third days, was the most critical period in the fumigation of eggs.

The use of ammonium hydroxide following fumigation seemed to be more effective in preventing embryo mortality as the concentration of formaldehyde was increased. The chief justification for its use is to shorten the disagreeble effects of fumigation.

PRACTICAL RECOMMENDATIONS

In the light of experimental results reported in this bulletin and of other fumigation research, the following practical recommendations are given:

The incubator and eggs should be clean and should otherwise conform to the best practices in sanitation.

Fumigation at high concentrations should not be made during the first three days of incubation because the embryos are then the most susceptible to formaldehyde.

Continued on next page

Eggs in the separate hatching compartments of an incubator should be fumigated on the eighteenth to twentieth days of incubation.

Eggs may be fumigated at time of hatching, but in no case should fumigation be delayed until the chicks have dried.

The formaldehyde solution should be standard 37% by weight (40 per cent by volume) commercial grade. It should be stored in a well-stoppered bottle.

WARNING: Do not permit formaldehyde solution to come in direct contact with the hands, for it may cause serious skin trouble. Wear rubber gloves when handling it.

Potassium permanganate should be kept in a colored bottle or moisture-proof container.

Just before fumigation, the humidity in the incubator should be raised to 92-94°F. wet-bulb reading. The fumigation should be performed at normal operating temperature.

Fumigation by the permanganate method requires the following items:

Measuring graduate or bottle for the formaldehyde solution.

Small balances or standardized measure for the permanganate.

Large earthenware or enameled dish for combining formaldehyde solution and permanganate. A large enameled wash basin or cooking utensil may be used.

Effective germicidal fumigation for pullorum by the permanganate method requires about 35 cc. of 37% by weight (40% by volume) formaldehyde solution and 17.5 grams of potassium permanganate per 100 cubic feet. Converted to the standard usually employed by hatcherymen, this proportion is equivalent to 1.2 fluid ounces of formaldehyde solution and 0.6 ounce permanganate per 100 cubic feet.

The dish should be placed on the floor of the incubator (or in the intake air channel), the permanganate placed in the dish, and the formaldehyde poured over the permanganate.

Ammonium hydroxide may be used after fumigation to shorten the period in which the disagreeable odor of formaldehyde is present. Some reduction in embryo mortality may occur with its use.

Control of mushy-chick disease requires two to three times stronger fumigation than the control of pullorum. Seventy to 100 cc. formaldehyde solution and 35 to 50 grams permanganate per 100 cubic feet is the concentration recommended for effective control of mushy-chick disease.

Continued on next page

Mortality with three times normal fumigation is not serious, and if necessary the treatment could be increased still more, provided the fumigating is done after the fourth day of incubation.

Fumigation by the cheesecloth method requires the following items:

Measuring graduate or bottle for the formaldehyde solution.

Cheesecloth of appropriate size.

Small hooks, tacks, or rods, for holding cloth in place.

Bucket or basin in which to immerse cheesecloth in the formaldehyde.

Rubber gloves to be worn while handling the cheesecloth saturated with formaldehyde. Warning! Serious skin trouble may occur if formaldehyde comes in direct contact with the hands.

When the cheesecloth method is used, pieces of cheesecloth about one yard square should be immersed in a sufficient quantity of formaldehyde solution to supply 20 cc. formaldehyde per 100 cubic feet in incubator space. The cloth should then be hung over rods near the fan and allowed to remain for three hours. (This method requires approximately two-thirds the quantity of formaldehyde needed in the permanganate method.)

Treatment by either method should last not less than one hour nor more than three hours.

If suitable measuring and weighing facilities are not available, the operator should consult his local pharmacist or photographer about the weighing or measuring of the needed materials.

The recommendations of the incubator manufacturer should be considered in fumigating with formaldehyde.

Agricultural News Letter (Du Pont)
Vol. 10, No. 1, Jan.-Feb. 1942

RATE OF NUTRIENT ABSORPTION BY DIFFERENT VARIETIES OF POTATOES IN AROOSTOOK COUNTY, MAINE

EDITOR'S NOTE:- Previous issues of the "Agricultural News Letter" have carried reviews of experimental results showing the rate of plant food absorption by various crops. Much of this information has been consolidated by the Du Pont Ammonia Department into a booklet entitled "The Rate of Plant Food Absorption and Its Relation to Fertilizers and Fertilizer Practice", copies of which will be sent on request. Below is the most recent contribution to this subject. It gives experimental results with Aroostook County potatoes and was prepared as a progress report to be included in the Annual Report of the Maine Agricultural Experiment Station now on the presses. It is published here by permission. A detailed discussion of the absorption of each element and the relationship of one element to another found in the plants and tubers of the same variety, and comparison between varieties, will be published later by the Maine Experiment Station in bulletin form.

By Arthur Hawkins
Agronomy Department
Maine Agricultural Experiment Station
Orono, Maine

It has been estimated that upwards of 80 pounds of nitrogen, 160 pounds of phosphoric acid (P_2O_5), 160 pounds of potash (K_2O), 30 pounds of magnesium oxide (MgO), and an undertermined amount of lime and sulphur in the form of mixed fertilizers are applied per acre of Maine's potato crop. Previous to this study the amount of these elements absorbed by a potato crop grown under Aroostook conditions had not been determined. The proportion of one element to another in the fertilizer formula and the total amount of each element applied to a potato crop has not been varied with variety. "The application of nutrients on a rational basis not only requires that the absorbing power of individual species for particular elements be known but that the optimum time for making these elements available to the roots of the growing plant should be considered."* Therefore it appeared advisable to determine the rate of plant food absorption by several varieties of potatoes having different lengths of growing periods. The varieties chosen were: Cobbler, early; Chippewa, intermediate; Green Mountain, late; and Smooth Rural (New York No. 2), very late. These varieties were grown under

* Lyness, A. S., Plant Physiology, 11: 665-688, 1936.

Continued on next page

different rates of fertilizer treatment, namely, no fertilizer, 1500 pounds, 2000 pounds, 2500 pounds, and 3000 pounds of a 4-8-8 per acre, on Caribou loam having a pH of 5.2 and the following levels of readily available nutrients: P, medium; K_2O, medium; CaO, medium to low: MgO, low.

Twelve (three from each of four plots) uniformly spaced two-stalk plants of representative size of each variety were taken from plots receiving no fertilizer, 2000-pound, and 3000-pound applications of a 4-8-8 fertilizer, at ten-day intervals, from the time that the plants were about six inches high to the time of serious loss of foliage, by maturity or early and late blight. Analysis was made of both the plants and tubers of these harvests to determine the total amount of major nutrient elements taken into the plant to a given date.

In this preliminary report for the sake of brevity, data will be presented for the most part on harvests of the Green Mountain variety from the plots which received 2000 pounds of a 4-8-8 fertilizer (containing 80 pounds of nitrogen (N), 160 pounds of phosphoric acid (P_2O_5), 160 pounds of potash (K_2O), 30 pounds of magnesium oxide (MgO), and an estimated 220 pounds of calcium oxide (CaO) and 75 pounds of sulphur (S)).

The amounts of the major nutrient elements absorbed by the Green Mountain variety at ten-day intervals are given in Table 1. These are calculated on the basis of a 100 per cent stand (plots were hand-planted, seed spaced 12 inches apart).

The data show that under 1939 conditions during the first fifty days after planting the Green Mountain variety absorbed 9 per cent of the total major nutrient elements while making 3 per cent of the season's growth. The remaining 97 per cent of the season's growth (7266 pounds) was divided as follows: between 50 and 60 days after planting, 7 per cent; between 60 and 70 days, 15 per cent; between 70 and 80 days, 26 per cent; between 80 and 90 days, 15 per cent; between 90 and 100 days, 16 per cent, and between 100 and 110 days, 18 per cent.

Of the 91 per cent of the major nutrient elements absorbed between the fiftieth and the 110th day after planting, 69 per cent was absorbed from the fiftieth to the eightieth day.

Less than 16 pounds of nitrogen had been utilized by the plant during the first fifty days after planting, but over 85 pounds was absorbed between the fiftieth and the eightieth day.

Twenty-seven pounds of phosphoric acid (P_2O_5) was taken up by the plants and tubers during the season. The absorption of potash took place very rapidly after the fiftieth day. Until that time only 15 pounds had been absorbed, but in the next thirty days, 160 pounds was absorbed per acre, and at about twice the nitrogen rate.

Only two pounds per acre of magnesium oxide was found in the plants on the fiftieth day but over 18 additional pounds was absorbed by the eightieth day, and absorption took place until the last harvest, to bring the total amount absorbed to 30 pounds.

Continued on next page

Table 1

Amount of Each Major Nutrient Element Absorbed per Acre by Potato Crop During Ten-Day Intervals of Growth (Green Mountain Variety) 1939

Period of Growth	Dry Weight produced per acre	Elements Absorbed per Acre by Plants* - Each Period						
		Nitrogen (N)	Phosphoric acid (P_2O_5)	Potash (K_2O)	Magnesium oxide (MgO)	Calcium oxide (CaO)	Sulphur (S)	TOTAL
Days	-Pounds Per Acre-							
0-50	237	15.8	3.2	14.9	2.0	3.7	1.0	40.6
50-60	499	26.1	3.6	47.2	4.0	9.4	1.6	91.9
60-70	1099	36.5	4.9	64.1	7.4	15.6	3.4	131.9
70-80	1866	23.0	7.4	52.6	6.9	11.4	1.7	103.0
80-90	1088	10.5	1.3	11.5	2.9	5.9	.5	32.6
90-100	1141	7.4	3.5	16.8	3.8	3.6	2.9	38.0
100-110	1336	22.1	3.2	0.0	3.5	5.0	1.1	34.9
	7266	141.4	27.1	207.1	30.5	54.6	12.2	472.9
Days	-Per Cent of Total-							
0-50	3	11	12	7	7	7	8	9
50-60	7	18	13	23	13	17	13	19
60-70	15	26	18	31	24	29	28	28
70-80	26	17	27	25	23	21	14	22
80-90	15	7	5	6	10	11	4	7
90-100	16	5	13	8	12	6	24	6
100-110	18	16	12		11	9	9	9
	100	100	100	100	100	100	100	100

* - Plants include tops, tubers, and most of the roots.

Continued on next page

The Green Mountain variety absorbed 54 pounds of calcium oxide (CaO) and 12.2 pounds of sulfur.

The amount of each major nutrient element absorbed per acre by the four varieties of potatoes in 1939 is given in Table 2.

Table 2

Amount of Each Major Plant Food Element Absorbed per Acre by Four Varieties of Potatoes 1939

Variety	Pounds of Each Nutrient Element Absorbed by Plants*						
	Nitrogen (N)	Phosphoric acid (P_2O_5)	Potash (K_2O)	Magnesium oxide (MgO)	Calcium oxide (CaO)	Sulphur (S)	Total
Cobbler	102.6	21.4	172.1	18.7	44.9	10.6	370.3
Chippewa	103.1	23.3	163.6	26.6	39.3	10.6	366.5
Green Mt.	141.4	27.1	207.1	30.5	54.6	12.2	472.9
Rural	128.5	24.5	211.4	30.5	59.1	10.7	464.7

* Plants include tops, tubers, and most of the roots.

The two later varieties absorbed about 100 pounds more total major nutrient elements than the earlier varieties. The later varieties absorbed considerably more nitrogen, potash, calcium oxide, and, as compared with the Cobbler variety, particularly more magnesium oxide. The magnesium oxide content of the tops and roots of the Cobbler variety was found to be considerably less than the content found in the other varieties, but comparatively little difference was found between varieties in the magnesium content of the tubers. The Cobbler variety absorbed only about 60 per cent as much magnesium oxide as did the later varieties in 1939.

The amount of nitrogen absorbed per acre by the four varieties of potatoes at 10-day intervals of growth are shown in Table 3 and Figure 1.

Continued on next page

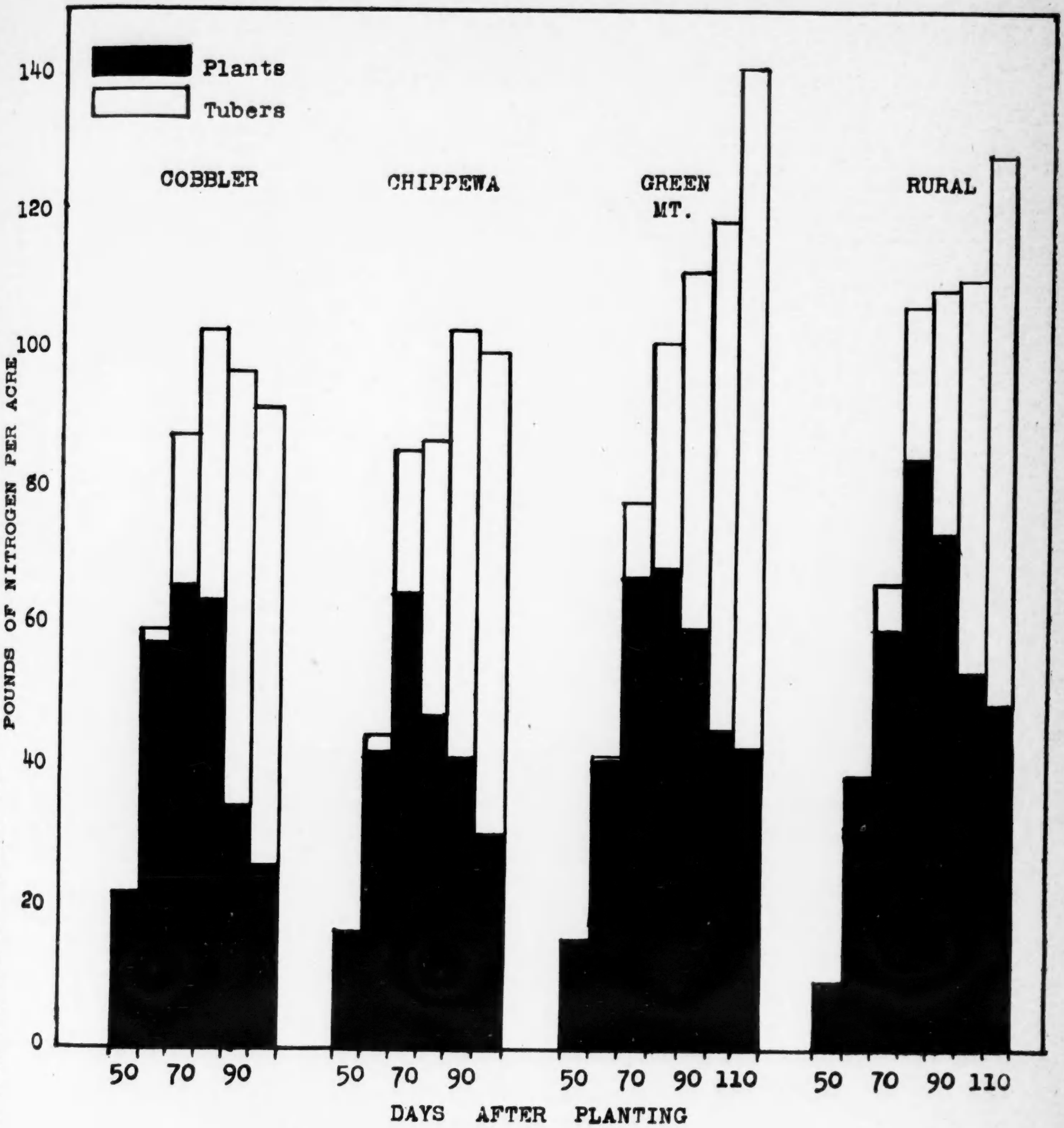

Figure 1. AMOUNT OF NITROGEN ABSORBED PER ACRE BY FOUR VARIETIES OF POTATOES AT TEN-DAY INTERVALS (50 to 110 days after planting).

Table 3

Amount of Nitrogen Absorbed per Acre by Four Varieties*

of Potatoes During Successive Intervals of Growth. (1939)

Period of Growth Days	Nitrogen Absorbed per Acre During Each Period							
	Cobbler		Chippewa		Green Mountain		Rural #2	
	lbs.	%	lbs.	%	lbs.	%	lbs.	%
0-50	23.0	22.0	17.4	17.0	15.8	11.0	10.1	8.0
50-60	36.7	36.0	27.7	27.0	26.1	19.0	29.2	23.0
60-70	28.2	28.0	41.1	40.0	36.5	26.0	27.1	21.0
70-80	14.7	14.0	1.2	1.0	23.0	16.0	40.2	31.0
80-90	0.0	0.0	15.7	15.0	10.5	7.0	2.3	2.0
90-100	0.0	0.0	0.0		7.4°	5.0	1.7°	1.0
100-110	**		**		22.1°°	16.0	17.9°°	14.0
	102.6	100.0	103.1	100.0	141.4	100.0	128.5	100.0

* Arranged in order of maturity--early, intermediate, late, and very late--left to right respectively.
** Plants dead.
° Dry weather.
°° Plenty of moisture followed dry period.

The Cobbler variety absorbed 22 per cent of its nitrogen requirements under 1939 conditions by the fiftieth day as compared with eight per cent for the Rural variety. By the seventieth day, Cobblers had absorbed 86 per cent of the nitrogen absorbed during the season as compared to 52 per cent for the Rural and 56 per cent for the Green Mountain varieties.

Agricultural News Letter (Du Pont)
Vol. 10, No. 1, Jan.-Feb. 1942

NYLON-BRISTLED GUN BRUSHES-ANOTHER CONTRIBUTION OF RESEARCH.

EDITOR'S NOTE: The last issue of "Agricultural News Letter", Vol. 9, No. 6, carried a report of results of research in the development of nylon-bristled brushes for use in bottle washing and pipe, cooler, and tube cleaning in the dairy industry. Below is information on results of experiments with nylon-bristled gun brushes, another field of interest to agriculture and rural life in general. In a year of tests, results of which are briefly reviewed below, these brushes proved superior to brushes with natural bristles, both in the laboratory and under actual operating conditions.

In a recent test in Outers' Laboratories, manufacturers of gun-cleaning equipment at Onalaska, Wisconsin, nylon-bristled gun brushes of many sizes wore seven times as long as natural-bristled brushes before becoming too gummy for service. After boiling in water for five minutes, these same brushes were serviceable for all practical purposes, and repeated the above performance, the laboratories report.

In search of a practical bristling material for gun brushes which would clean more easily than natural bristle, and yet not soften in such cleaning solutions as boiling water and acetone-base solvent, Outers' Laboratories pioneered in nylon experiments.

Nylon-bristled brushes were found stiffer than natural-bristled brushes and less stiff than metallic brushes. The cut ends of nylon filament, the laboratories report, retain their brushing surface several times longer than natural bristle.

Nylon bristles have shown the same superior qualities for gun brushes as for other industrial brushes. Their moisture absorption is only about 20 per cent that of hog bristle, allowing them to retain stiffness and avoid a limp and soggy condition after long hours of continuous use in moisture.

Manufactured in mechanically controlled diameters, nylon bristles resist abrasion and do not fray or split. They stand up well under constant flexing and whirling. Owners of fine guns, rifles and pistols have found them very satisfactory.

One manufacturer predicts that nylon bristles soon will replace all natural bristles for this purpose. Nylon-bristled brushes, he said, retail for the same as brass and natural bristle brushes and lower than phosphor-bronze brushes.

Extension of nylon to gun-brush manufacturing indicates the brush industry's swift acceptance of a chemically synthesized bristle which was introduced three years ago. Nylon-bristled brushes already are used extensively in the textile, dairy, dry cleaning, electroplating, bottle washing and other industries.

Agricultural News Letter (Du Pont)
Vol. 10, No. 1, Jan.-Feb. 1942.

THREE-DIMENSIONAL SEEING

EDITOR'S NOTE: Further investigations to determine the effect of paint color contrast on surrounding surfaces and on utilization of light as a seeing tool show that proper selection of color contrast on machine parts, plus a well-designed lighting system, definitely increase the accuracy of seeing. This increased accuracy aids in reducing personal accident hazard, increases output, and produces more comfortable working conditions for machine-tool and similar operations. The information developed by these investigations, briefly reviewed below, will find its chief application in connection with machine tools and ultimately with factory machinery in general. Agricultural engineers and others interested in the farm will find use for it in farm machine shops, in rural industry, and in the farm home. Copy of a new booklet on this subject will be sent on request.

Twelve years ago a New England shoe manufacturer was hearing complaints from his machine operators. They had headaches. Now and then spots would dance before their eyes. He seated himself on the sidelines to watch his operators at work.

He studied a man finishing a black shoe on a black machine. Noticing that the shoe and the machine blended into one dark mass, the manufacturer acted on a sudden impulse and told the operator to go to the paint shop, select a pleasant color, and then clean and paint his machine anew. It wasn't long before the other workers in the plant followed suit. The shop glittered with every gaudy color in the rainbow. And it is said that accidents fell off nearly 70 per cent. Operators claimed they felt far less fatigued. Fewer "seconds" came through, output increased.

Other rule-of-thumb experiments based on this simple, commonsense idea were tried by factory operators, but it was inevitable that sooner or later scientific research would come to decisive grips with lighting and "seeing" conditions in shops, where, despite this highly mechanized age of mass production, results still depend largely upon the speed and accuracy of the men who run the machines, and whose nimble fingers are no better than the eyes that guide them.

Improved Vision in Machine Tool Operations by Color Contrast

With national production aiming today at constantly higher peaks, an announcement made at the recent annual convention of the Illuminating Engineering Society at Atlanta, Georgia, was particularly timely. Arthur A. Brainerd,

Continued on next page

director of the Lighting Service Section of the Philadelphia Electric Company, in collaboration with E. I. du Pont de Nemours & Company, Inc., revealed the results of a two years' field investigation into the problem of "Improved Vision in Machine Tool Operations by Color Contrast."

His paper dealt with a new endeavor. Aptly, Du Pont color technicians named it Three-Dimensional Seeing.

Using the New England shoe manufacturer's discovery of a dozen years ago as a starter, Brainerd showed that research had dug exhaustively into the problem of providing natural seeing conditions indoors, and had uncovered facts meriting the attention of every industrial producer. The collaborators assert that Three-Dimensional Seeing results in:

1. Increased production.
2. Reduced personal accident hazards.
3. More comfortable working conditions.
4. Improved labor relations.

What then, precisely, is Three-Dimensional Seeing? In answering the question, it will be wise to present the investigators' line of reasoning from the beginning, and follow along the path of their research, as outlined at the Atlanta meeting of illuminating engineers.

Machines are most frequently painted dark green, deep gray, or black, and thus afford almost no color or brightness contrast to the material under fabrication. The average factory walls and ceilings seldom reflect as much light as they should. Dingy walls, ceilings, and dark-painted machinery "soak up" both sun and artificial light. In such surroundings, piling on light does not produce the expected improvement in seeing. It is an example of camouflage.

Improved vision is not entirely a question of brightening up reflecting surfaces. Contrasts in color are also important, and the least understood phase of the problem.

Following Nature's Lead

"Consider the outside world of Nature," scientists say in pointing out the value of color contrast in furthering strainless, full vision. Nature provides a blue sky, white fleecy clouds, an orange-red sun, green grass, gay flowers, and brown earth. Everywhere, varieties of hue and brightness lessen the load on the eyes.

Following Nature's lead, much has been done to improve visibility in offices and homes by means of correct brightness and color contrasts. But in machine shops comparatively little attention to scientific lighting efficiency has been paid, and even less attention has been given to the color of machines.

For example, bandsaws are old enemies of safety. Usually they are so "camouflaged" with dull gray paint that danger points are difficult to distinguish. The same is generally true with millers and lathes. Yet the fact is that it is no more

Continued on the next page

sensible to obscure the working areas of machines - potentially dangerous or not - by an overall coat of traditional dark gray paint, than it would be to finish the keys of a piano in the same color as the mahogany or walnut piano case. In demonstrating how "danger points" of working machinery can be emphasized through the scientific use of colors, it is not intended that color be substituted for adequate guarding, but rather that it be used to indicate hazardous locations. Mechanical guarding and personal protective equipment should, of course, be provided according to insurance regulations and individual state requirements.

The Experiment

To duplicate average conditions, two machine tools in a typical repair machine shop doing a wide variety of work were selected for the Du Pont-Philadelphia Electric color and light tests. Since colors vary under different types of light, both incandescent and mercury-lighting equipment were installed for the machines under observation. The original battleship gray of the machines, which is very low in ability to reflect light, was painted with colors having good light reflecting characteristics. Each machine was completely repainted with one of these semi-gloss, oil-resistant, washable machinery paints every second Friday.

Over a period of several months these colors were tried out: aluminum, light gray, light green, yellow, light blue, light buff.

Photometric readings were recorded of the light falling on the working surfaces of the machines, and of the light reflected from them. To determine the psychological effect of the various colors upon the workers, a simple questionnaire was put before a group of 15 men, including two foremen.

They were asked the following six questions after each color had been in use:

1. Is the new paint color more or less tiring than original?
2. Can you see better than with original?
3. Can you work faster than with original?
4. Is it easier to do better work than with original?
5. Do you need more light?
6. Do you think it's safer than before?

The results of the questionnaire and the reflection brightness measurements were correlated with the timed operating efficiency of the workers performing standard tasks at their machines.

What colors had the highest rating?
Light buff and light gray.

This excursion into the unexplored field of improved vision by color contrast was, at this point, essentially theoretical. The maintenance department was yet to be consulted. The idea of painting machines light buff might be impractical, and that is just what the maintenance men promptly said it was.

Continued on the next page

Machines Medium Gray Spotlighted With Light Buff

As a compromise, accordingly, all machines were painted a medium gray with light buff around the working area. The purpose was to utilize the light reflecting possibility of the light buff finish and still satisfy maintenance requirements. Surprisingly, the combination performed better than any of the solid colors.

This two-color system, the collaborating companies reported, has been in use since September 1939. Mechanics are so pleased with its benefits, that they tend to keep the light buff areas - where work and accident hazard is "spotlighted" - clean.

Advanced Field Investigations Under Way

Advanced field investigations are currently being conducted in several industrial concerns, and it is expected that more complete data will be available in the near future. However, results to date are sufficiently conclusive to warrant management giving serious thought to adopting the Three-Dimensional Seeing idea. Inasmuch as they indicate it is a production-accelerator, an accident-reducer, and a morale-builder in tests confined thus far to machine tools, there is every reason to have confidence in the value of its adaptability for factory machinery in general.

Technical Service and Motion Picture Available

So enthusiastic, in fact, are the technicians in Du Pont's Finishes Division that they have named the winning paint colors of Three-Dimensional Seeing - "spotlight buff" and "horizon gray." Moreover, they are offering gratis a technical service in the field, and have made a color motion picture of this new method of harnessing brightness and color contrast for better vision for the men operating America's industrial machines.

########